DEVELOPMENT OF A GAME-BASED COURSEWARE FOR SLOW LEARNERS

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CERTIFICATION OF APPROVAL

Development of a Game-Based Courseware for Slow Learners

By

Hilary Anak Stephen

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Approved by,

(Assoc Prof Dr. Wan Fatimah Bt Wan Ahmad)

UNIVERSITI TEKNOLOGI PETRONAS
TRONOH, PERAK
July 2010

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

HILARY ANAK STEPHEN

ABSTRACT

Education is important to all level of people. It is as a key to success in life, but not all people can do well in their education for some reasons. Some people face some difficulties in learning because of their family background, behavior or characteristics, interest, knowledge levels and so on. The purpose of this project is to develop a courseware application for slow learners. The scope is for children at the age of six to nine years old and focus on slow learners in the topic of Mathematical operations. It is also focused on the game-based learning in order to help the slow learners to improve their knowledge in learning process. Slow learner has a problem with the learning method and poor memories. These children do not get sufficient attention in the mainstream education. They usually fail repeatedly in examinations. Establishing special schools for children in this category is not practical. It is ideal to evolve strategies to provide education to these children in normal schools itself. The system is developed using a Rapid Application Development (RAD). This methodology gives much faster development and higher-quality results while reducing development costs and maintaining quality. The system is expected to improve the current learning process for the slow learners. By using this game-based courseware, the slow learners can learn in effective and interactive manner. It provides a dynamic learning environment for the slow learners to acquire the knowledge and strengthen their skills. It is hoped that slow learners will improve their understanding in learning process by using a game-based courseware.

ACKNOWLEDGEMENT

The author would like to express his heartily thankful to his supervisor, Assoc Prof Dr. Wan Fatimah Bt Wan Ahmad, Senior Lecturer, Department of Computer Information Science, whose encouragement, guidance and support from the initial to the final level enabled him to develop an understanding of the final year project. Her wide knowledge and her logical way of thinking have been of great value for him. Without her, this project would not have been possible. Her feedbacks, comments and suggestions were helpful throughout the entire research and study.

The author would also like to take the opportunity to thank those people who spent their time and shared their knowledge for helping him to complete his report and project with the best possible result.

Lastly, the author offers his regards and blessings to all of those who supported him in any respect during the completion of the final year project. Their help and support is highly appreciated. Thank you very much.

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INTRODUCTION

1.1 Background of study

In schools, teacher is possibly to have three to five students who are slow learners. It is very important for teacher to allocate the time and learn how to accommodate these kinds of students in classrooms. Slow learners can be defined as a person who has a tendency to take longer time to understand a new concept than the normal person. Slow learners also someone who needs several or various explanations to get them understand a concept. Usually, in order to effectively meet the slow learners' needs, the teachers have to educate and motivate themselves and keep a good and open communication with the parents.

Most of people thinking that slow learners may be slow in reading and arithmetic, but not necessarily slow to the same extent. They may be able to learn better in mechanical or social activities. They may also be faster adapting in play activities, work or sports. Abstract thinking is difficult for a slow learner and their attention span is short. A slow learner reacts slower than average, self-expression is awkward and self-esteem is low. Most of them found difficulty to figure things out themselves, especially if given multiple and complex step instructions. Most slow learners function below grade level in all subject areas and generally score consistently low on achievement tests.

The goal of helping a slow learner is to get them performing at their highest level as possible like the other normal students did. They have ability to score in their study but the learning strategic may be different. It is applicable to

develop a game-based courseware for slow learners. They like to learn something in different way instead of abstract concept. This courseware designed with interactive interfaces and easy to use by the slow learner. It is based on educational games and focus on Mathematical operations. The slow learner will not feel boring while using this courseware and keep focus on what they are doing. The process flow of the application to be developed will emphasize on the effective of learning strategy. It makes learning fun and comfortable for slow learners.

1.2 Problem Statement

Slow learners are whose have difficulty learning abstract concepts. A slower learner has desire to learn, but has a problem with the learning method. They do not easily master skills academic in the nature and have poor memories. To address this problem, develop a game-based courseware may be able to improve the process of learning among the slow learners.

1.3 Objectives and scope of study

The objectives and scope of the system are as follow:

1. To investigate the learning strategies for slow learners.
2. To determine the design requirements in order to develop a prototype for the courseware.
3. To develop a game-based courseware for slow learners in Mathematical operations based on the design requirements.

CHAPTER 2

LITERATURE REVIEW

In general, a good and effective learning strategic is very crucial to help a person to easily understand a new concept. The formal way of learning is involve both teacher and students. It is conducted manually in the classroom. Possibly, there are some students whose face difficulties in this learning strategic. They found that it is not an interactive way of learning. This kind of students can be categorized as the slow learners. Add variety to the academic routine by using a game-based courseware may be can improve the learning strategic. Below are some of the literatures reviews. This section contains the references in development of the game-based courseware for the slow learner. The sources of all the material used are well cited in the reference section.

2.1 Courseware system and slow learner

Courseware can be defined as computer software used in teaching and to support learning process which is can be access through appropriate interface and structuring of the instructional materials (Schneider, 1995). It is as a kit for teacher which can help them to teach the students. According to Sandberg (1994), the role of technological support in education is to determine the elements of a technologically wealthy and help to optimize the learning strategies. Some teachers are face challenges when the students have some difficulty to learn new concepts. This could happen when some students slow to capture and learn new concept. This kind of student categorized as the slow learner. These students need more time, more repetition, and addition resources to help them successful in academic (King. 2006). Some of the common characteristics of the slow learner are some of them think they were not have ability or skills in learning process (King. 2006), felt anxiety, not confident with themselves, quick to give up when do something difficult. They can

success like the other normal student if they are interesting to learn new concept by using the courseware system.

2.2 Mylexics overview

Research on the existing courseware was based on the Mylexics. Mylexics is a courseware that has been developed in Malaysia to help the dyslexic children to learn basic Malay Language. It helps dyslexic children interactively learn to read and write in Malay Language. This courseware application was developed based on 'Dual coding theory' by Allan Paivio (Paivo & Begg, 1981). Dual coding theory was applied which can support verbal and non verbal objects, events and behavior. This is combined with instruction Scaffolding (Wood et al. 1976) which provide adequate assistance to guide the student to interact with the application alone. The layout or flow chart of this courseware was attached in the appendix. Mylexics was developed based on video approach and use CD. This type of courseware encourages self-learning which is flexible to use by student whether at school or home. This application was integrated with all multimedia features and makes it become more interactive and user friendly. This courseware was developed with three sub-modules which are consisting of alphabet, syllables, and words.

At the first level, the student will learn the alphabet which consisting of vowels and consonants. At this stage, it is important for student to be able recognize the sound and the letter. Then the children will learn to merge the alphabets to create two types of syllables. Last but not least, the children ask to use that syllables to create or construct word. By using it repeatedly, it will help the dyslexic children learn faster on constructing word in Malay language. The courseware layout and some of the Mylexics interface layout shown as figures. (Figure 2.1, Figure 2.2, Figure 2.3, Figure 2.4, Figure 2.5, Figure 2.6, Figure 2.7)

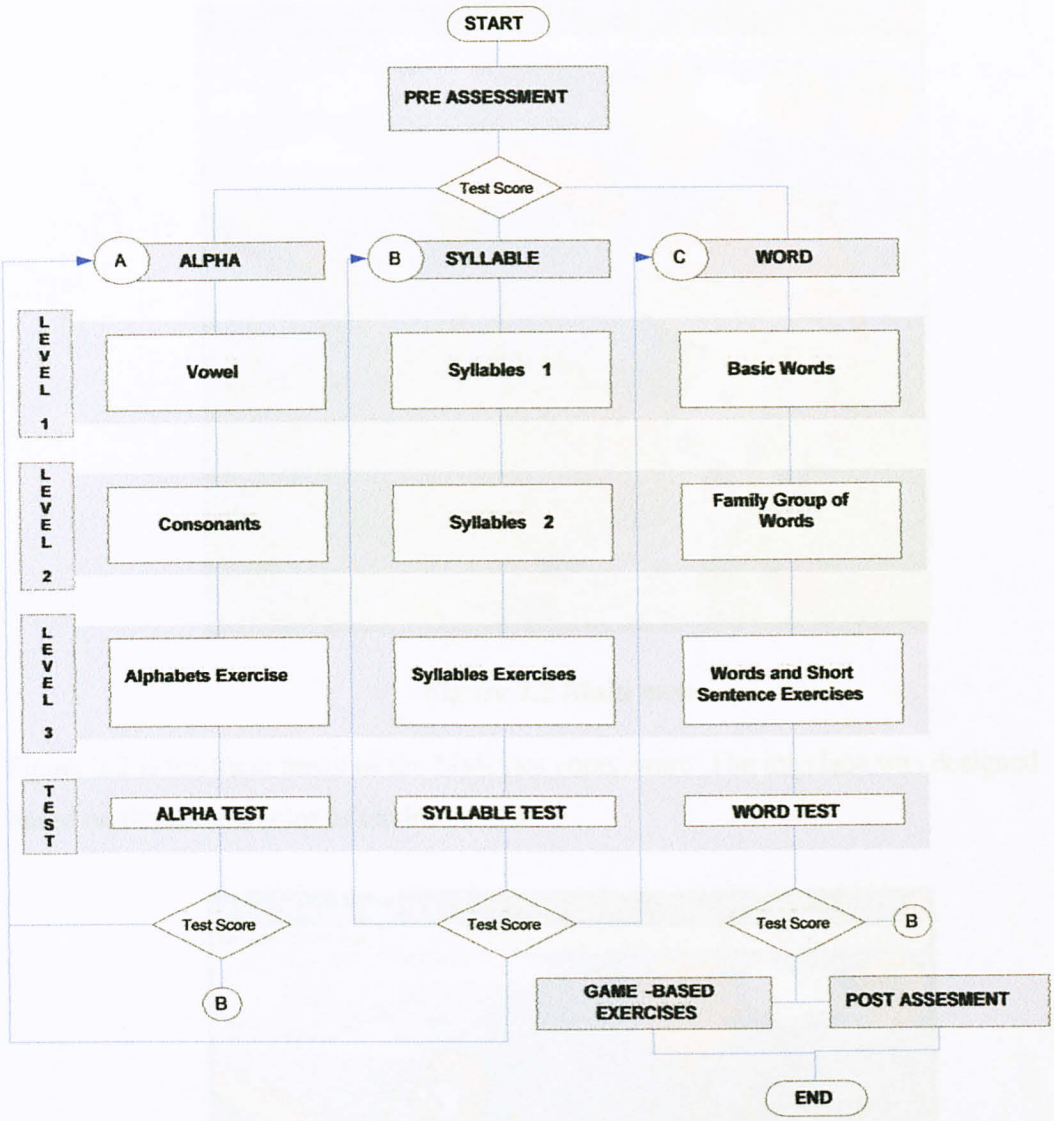

Figure 2.1 Mylexics courseware layout. Adapted from (Abdullah L.,Hisham, S& Parumo S, 2009)

Figure 2.2 Main menu

Figure 2.2 is the main menu of the Mylexics courseware. The interface was designed based on the natural color of environmental.

Figure 2.3: Courseware modules introduction

Figure 2.3 shows the list of activities that the dyslexic children can learn from Mylexics courseware. It was written in Malay language, so that, it is easy for the children to understand.

Figure 2.4: Letter formation and sound identification

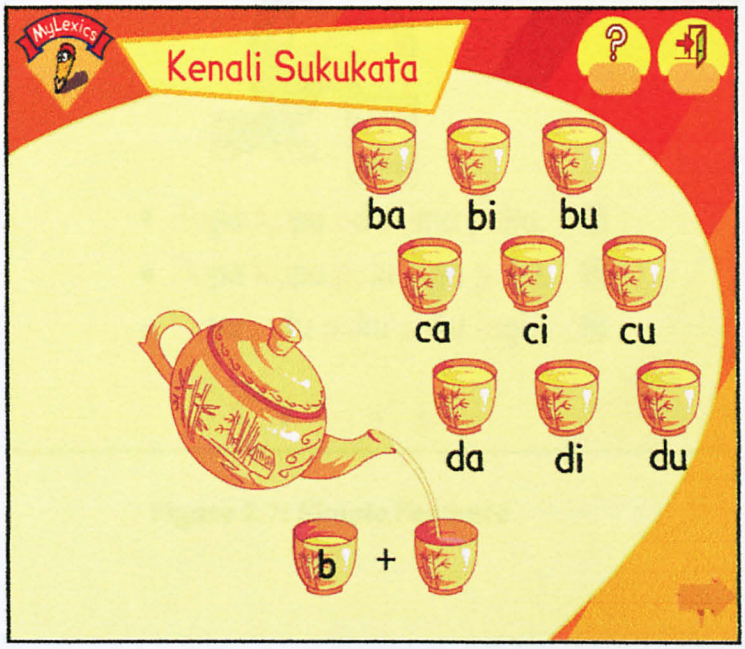

Figure 2.5: Learning Syllables

Figure 2.6: Basic words

Figure 2.7: Simple Sentence

2.3 Game-based learning design and development

Nowadays, the increasing number of educators who believe computer games may be effective tools for education (Gee, 2003; Prensky, 2001; Aldrich, 2004; Elliot, Adams, & Bruckman,2002). Develop a good game not an easy task. It is more difficult task to develop an educational games because lack of content and ideas to present it as an educator. There is a combination of twelve aspects why games engage us according to Prensky and which are shown in Figure 2.8.

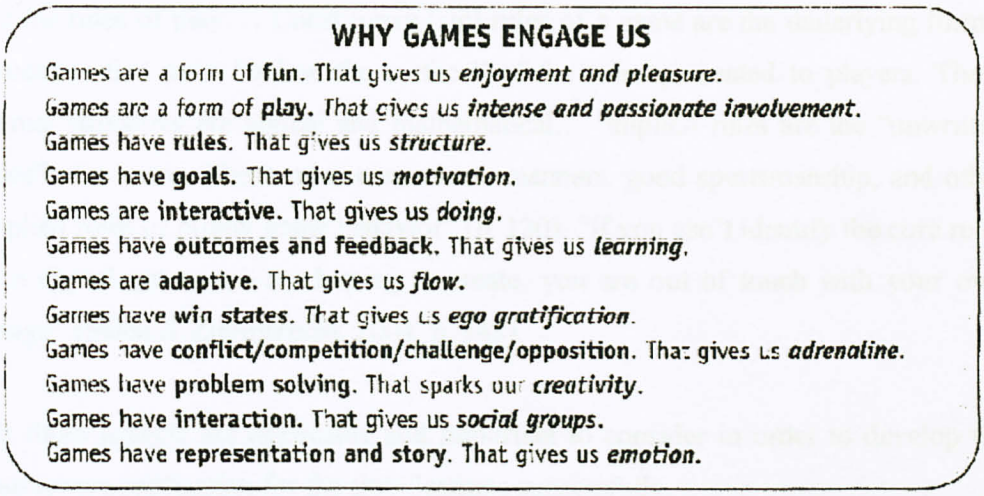

Figure 2.8: Why games engage us. Adapted from (Prensky, 2001, p. 106).

A good and high quality of game-based learning should meet all the combination of twelve aspects. A successful game-based learning should have a balance in order to acquire a high level of engagement and also integration of learning information (Van Eck 2006, Van Eck and Gikas 2004, Prensky 2001). The educational aspects integrated within the game and a high level engagement within the game interface. The main reason why conducted on a game design research is primarily to determine the consequences on chosen of genre, user interface and structure of game which should be included on creating a successful game.

The important aspect in maintaining game play is the user interface in which the game is created. It is the medium where the user can interacts with the game application. According to Prensky (2001) "...game interfaces do not have to be, nor

in many cases should they be, simple and intuitive" (p. 172). Simple and intuitive interface will allowing user with different level of skill and knowledge easy to learn as they go along.

Rules are another important aspect when developing a game-based learning. "Rules are what differentiate games from other kinds of play.... If you don't have rules you have free play, not a game" (Prensky, 2001, p. 119). There are three types of rules that construct games which are operational, constitutive, and implicit.(Salen and Zimmerman, 2004). According to Salen and Zimmerman (2004): "Operational Rules are the rules of play.... Constitutive [sic] rules of a game are the underlying formal structures that exist "below the surface" of the rules presented to players. These formal structures are logical and mathematical.... Implicit rules are the "unwritten rules" of a game. These rules concern on manners, good sportsmanship, and other implied rules of proper game behavior" (p. 130). "If you can't identify the core rules of a digital game you are hoping to create, you are out of touch with your own design" (Salen & Zimmerman, 2004, p. 148).

All those aspects are applicable and important to consider in order to develop the courseware application for the slow learners successfully.

2.4 Software for development process

Selection in software was an important subject in the construction and release game-based learning application. The application to be designed is based on game based learning. It will focus on animation based on flash application. Animations are usually more effective than comparable to the static graphics in situations. (Tversky et al. 2002). According to Holzinger & Ebner, 2003, Flash is one of the major tools for creating content for the interactive application. ActionScript is the object-oriented programming language for the Flash platform. By using flash the possibility to develop usable visualizations of the application models is more quickly. The selected software was Macromedia Flash 8 and added with ActionScript 2.0 as the programming language to edit and manipulate the objects. This software is a multimedia platform that is well known for designing and developing interactive games.

2.5 Mastery learning approach

Learning is something that necessarily and the most important in life. Every human being spends most of their time to learn something new whether it is technical or theory subjects. Mastery learning is an approach which is consisting of an instructional strategy based on the theory that all students can gain knowledge from a set of objectives with proper instruction and adequate time to learn (Kazu et al. 2005). The teaching method is based on ordered steps. In order to proceed to the next level, students have to master the previous steps. Students must demonstrate mastery on each step, typically 80%, before can move on to new instruction. Mastery learning strategy providing the students more than one chance or can be called retest if they are fail to achieve the minimal score or until mastery is met. Retest or retry on the instruction methods will help them to correct their misunderstandings. Mastery learning also can help the students to understand better on the subject matter and know more about what they are going to discover.

The objective of mastery learning approach is to produce good students with better knowledge in subject matter. It is consist of good achievement, positive attitude, and high motivation with more effective learning method. (Ghani et al. 2006).Three aspects how mastery learning can help in effective way in education (Cohen, et. al., 2002)

I. Curriculum: For this aspect, it focuses on the process of mastering the content of learning area. It works best when there are well-defined of learning objectives and in sequence of organized units.

II. Instruction: The instructor will provide the instruction to the student at the first phase and teach them how to master it. The instructor also gives specific feedback on every single task by using diagnostic or formative tests. They also help students to correct misunderstanding that students make during their learning path.

III. Assessment: The instructors evaluate students with criterion-referenced tests rather than norm referenced tests. There are frequent feedback loops in mastery learning to ensure that every single unit of test can be mastered by student with appropriately order of the outcomes or learning results.

Integrating the mastery learning in the Math game development process is essential to make it more effective and a good learning medium for the slow learner, so that, they can success and master the Mathematics subject very well.

The mastery learning model can be derived as shown in figure 2.9:

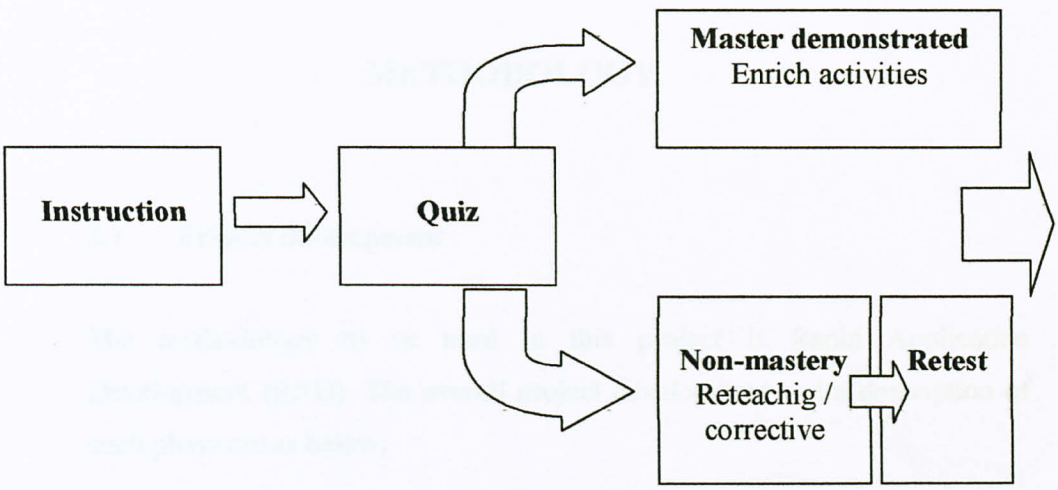

Figure 2.9: Mastery learning model (Adapted from www.lauracandler.com)

CHAPTER 3

METHODOLOGY

3.1 Project development

The methodology to be used in this project is Rapid Application Development (RAD). The overall project development and a description of each phase are as below;

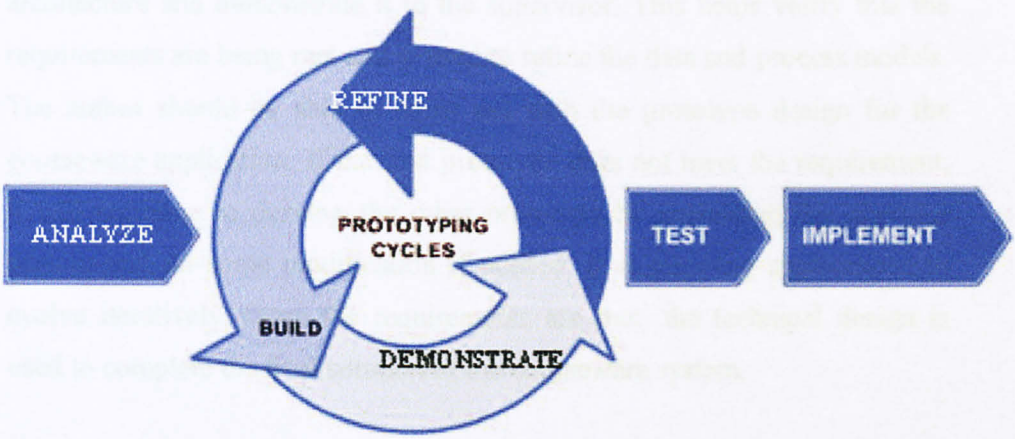

Figure 3.1: Rapid Application Development (RAD) methodology.

3.2 Description of the project development phases

3.2.1 Analyze

At this phase, the author started identifying the topic for the project and write up the proposal. Once the project was approved by the FYP committee and a supervisor, the author start to analyze the requirement needed and develop

the preliminary report. The author also do analyze on available courseware that have done by the other which was almost similar and get information based on the project title and decide the research methodology (literature review) as a guidance for future stages.

The author needs to write the documentation during analyze phase. (Reports and graphs may be changing all along the project lifetime) to ensure that all the documents are up to date to facilitate the requirement for any intended future development project.

Analyze on existing application which is Mylexics application give an overview for the project development.

3.2.2 Prototyping cycles

During this phase, the system was basically designed and modeled. In this phase, the author needs to develop or build the prototype based on system architecture and demonstrate it to the supervisor. This helps verify that the requirements are being met and is used to refine the data and process models. The author should be able to come out with the prototype design for the courseware application. If the first prototype does not meet the requirement, it will continue to develop the other prototype by enhancing the previous version and do some modification if needed. It is allowing applications to evolve iteratively. Once the requirements are met, the technical design is used to complete the final solution of the courseware system.

3.2.2.1 Layout for the Math game-based courseware

The application to be developed is Mathematical operations game-based learning for the slow learners. The Figure 3.2 is the overview of the courseware layout for the Math Game application for the courseware.

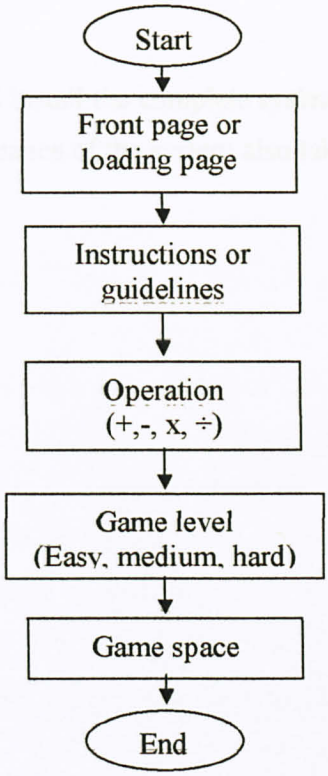

Figure 3.2: Math game-based courseware layout

The details diagram on the flowchart of process flow module and use case diagram can be found in result and discussion. By using the flowchart, it will give better understanding of the process. It also helps to identify problems areas and opportunities for the process improvement.

3.2.3 Testing

Once the final prototype was agreed by supervisor, it is ready to be tested. At this phase, the author prepares the system test plan. All the individual modules will be tested and to ensure synchronization of the modules. The author will test the integrated system to ensure all the function can be running well. The deliverable at this phase is the tested courseware system.

3.2.4 Implementation

At this phase, the author will install the complete system and trains the users on how to use it. The maintenance of the system also takes into consideration during this phase.

CHAPTER 4

RESULTS AND DISCUSSION

Develop the courseware system that using the touch screen technology for the slower learner is a good contribution for their education. Do a deep analysis and study on the existing application based on touch screen technology will help the author gaining some ideas to carry on this project. After had done on several analysis on the existing application, the author has come out with an application called Mathematical game-based learning. There are some of the results and discussion discovered based on the information gained from the literature review.

4.1 Unified Modeling Language (UML)

The construction of a use case model was an excellent way to represent the overview of the functional requirements in the Game-Based courseware for slow learners. The scope of the application was based on Mathematical operation. The activity consists of identifying use cases and actors and describing the details of each use case.

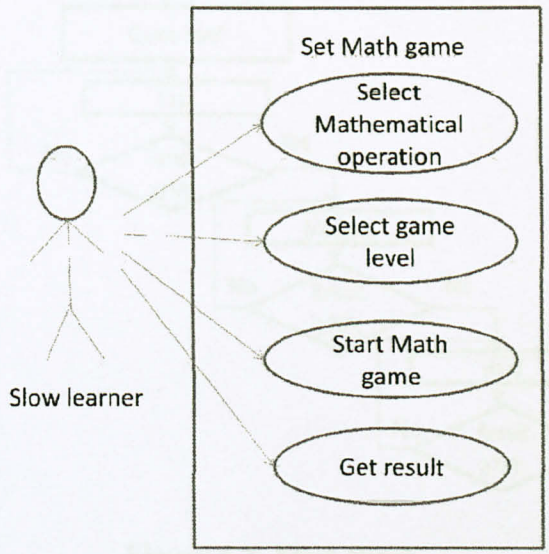

Figure 4.1: Use Case Diagram

The use case diagram above describes what services (use cases) that are available for users (Slow learners). To interact with the application, firstly, slow learners have to select the Mathematical operation. It is consist of four operations which are addition, subtraction, division, and multiplication. Then the slow learners will start with easy level. Only if he or she who can pass the easy level, then he or she can proceed with the medium and then hard level. The details of process flow will be describes in the flow chart.

4.2 Flow chart

The creation of the flow chart is to represent the process flow of the application in details. The flow chart of the Math Game based courseware for slow learners was derived as figure shown below.

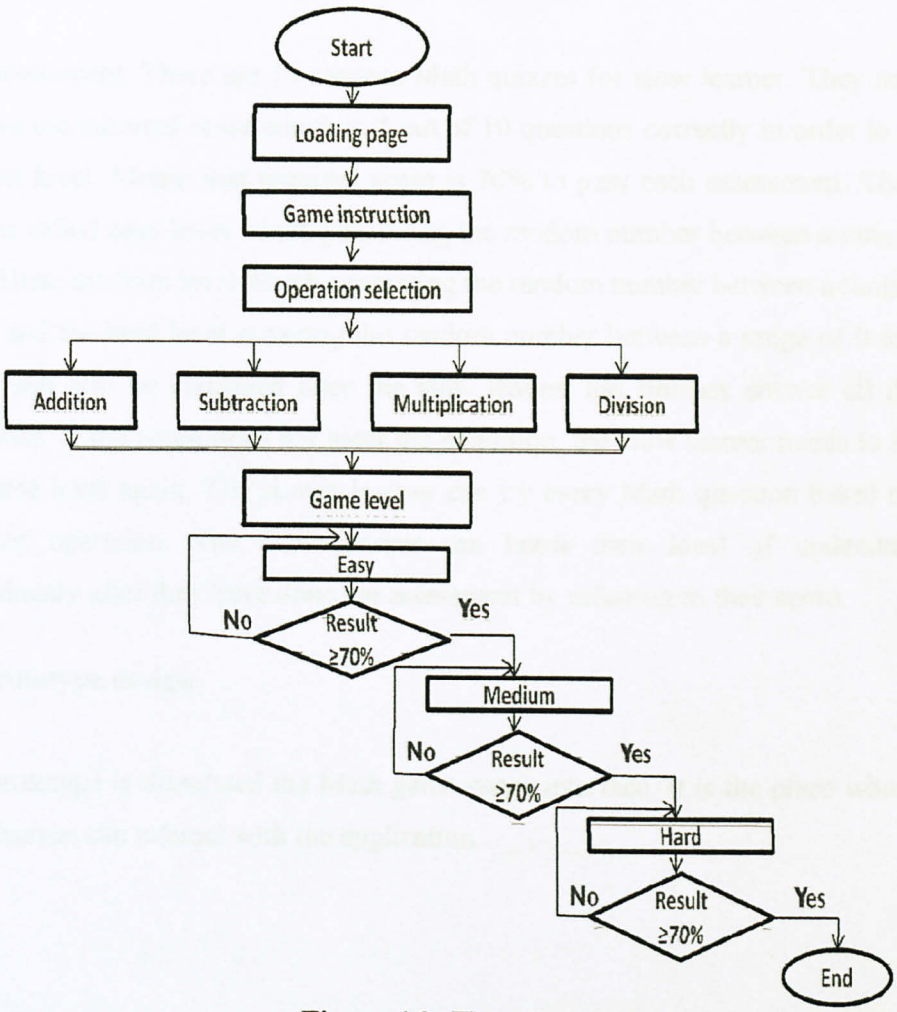

Figure 4.2: Flow chart

This application is based mastery learning strategic. It offers a learning process model in which each slow learner has to pass an assessment before she or he can proceed to the next level or next instruction unit. Based on the application, the first stage is the front page or loading page. In this stage, the slower learners can see the preview of the application. The second stage is the instructions or guidelines. It will show the ways how to interact with the system and how does the application work. For the third stage, the slower learner will prompted to select one of the Mathematical operations which are whether addition, subtraction, multiplication, and division. Then it will proceed to prompt the slow learner to select the game level. There are three levels of difficulty which are easy, medium and hard. At first, the slow learner need to answer the easy level successfully before can proceed with medium level and then hard level.

The assessment: There are 10 random Math quizzes for slow learner. They need to achieve the minimal score which is 7 out of 10 questions correctly in order to move on next level. Means that minimal score is 70% to pass each assessment. The first level is called easy level which generating the random number between a range of 0 to 9. Then, medium level which generating the random number between a range of 0 to 99 and the hard level covering the random number between a range of 0 to 999. The result will be displayed once the slow learner has finishes answer all the 10 questions. If the result does not meet the condition, the slow learner needs to repeat the same level again. The slower learner can try every Math question based on the selected operation. The slow learner can know their level of understanding immediately after they have done the assessment by referring to their score.

4.3 Prototype design

The prototype is illustrated the Math game space interface. It is the place where the slow learner can interact with the application.

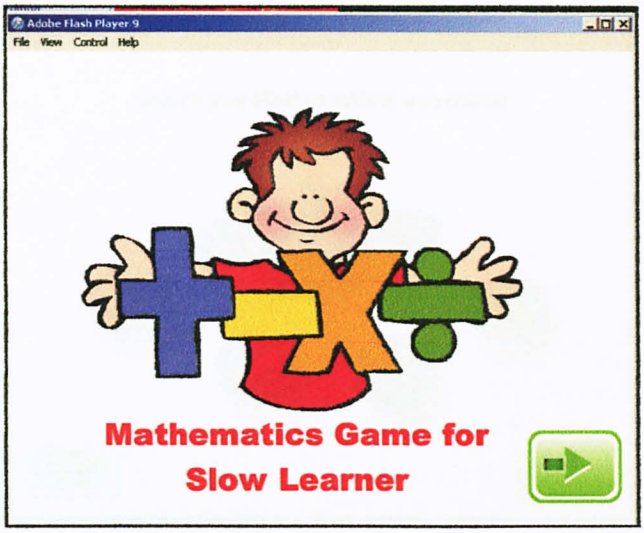

Figure 4.3: Loading page

The above figure (Figure 4.3) is the loading page or front page of the Mathematics Game for slow learners. The cartoon at the middle represents the overview of the application which is consists of four Mathematical operations.

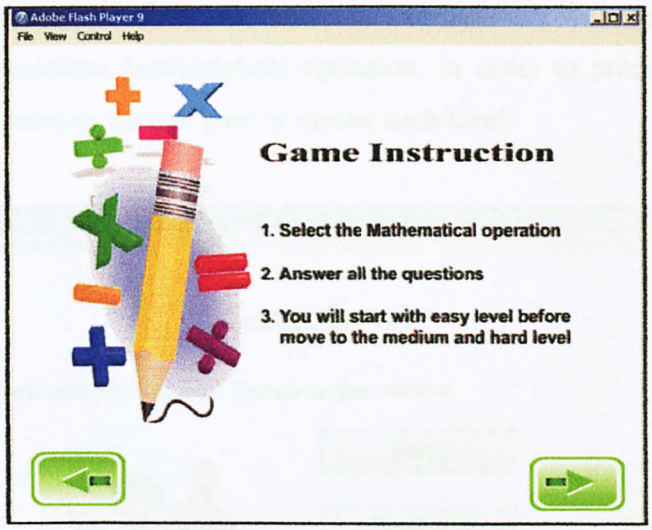

Figure 4.4: Game instruction

Figure 4.4 is the interface of the game instruction. The instruction was simple and straight forward, so that it was easy for the slow learners to capture before proceed to the next step. It was written in English language.

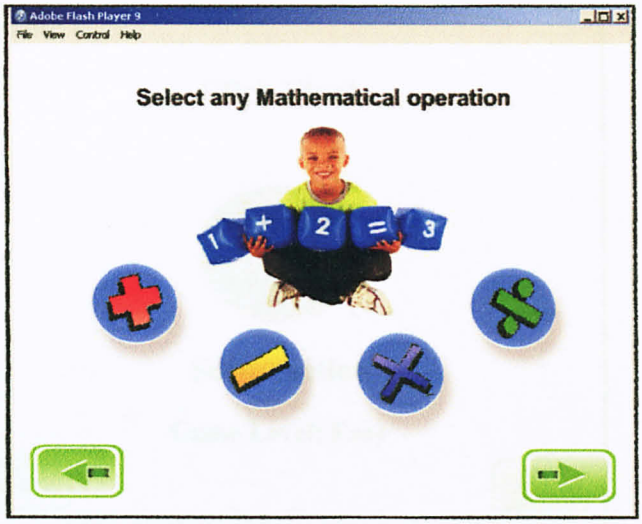

Figure 4.5: Operation selection

Figure 4.5 is the interface of the Mathematical operations selection. From here, the slow learners can select any one out of four Mathematical operations. Then, it will proceed with the game level interface as shown in Figure 4.6. There were three game levels which are easy, medium and hard. The slow learners will start with the easy level for every selected Mathematical operation. In order to proceed to the next levels, the slow learners need to pass or master each level.

Figure 4.6 Game levels

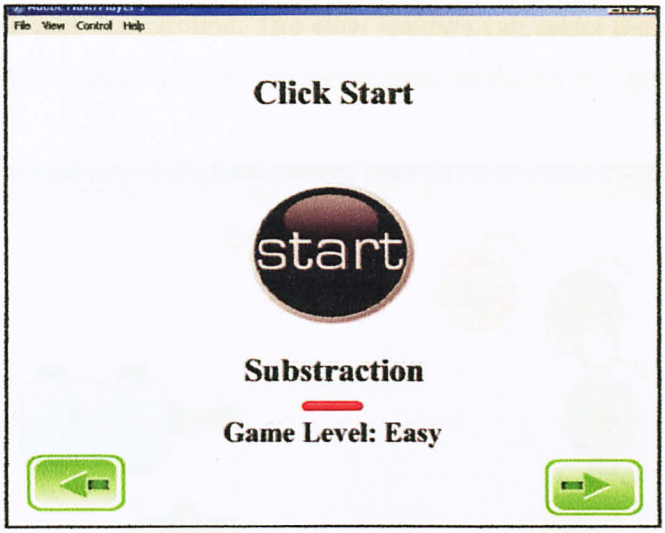

Figure 4.7 Start button

The Figure 4.7 represents the interface of start button. By pressing the start button, the slow learners will proceed to the Math game space.

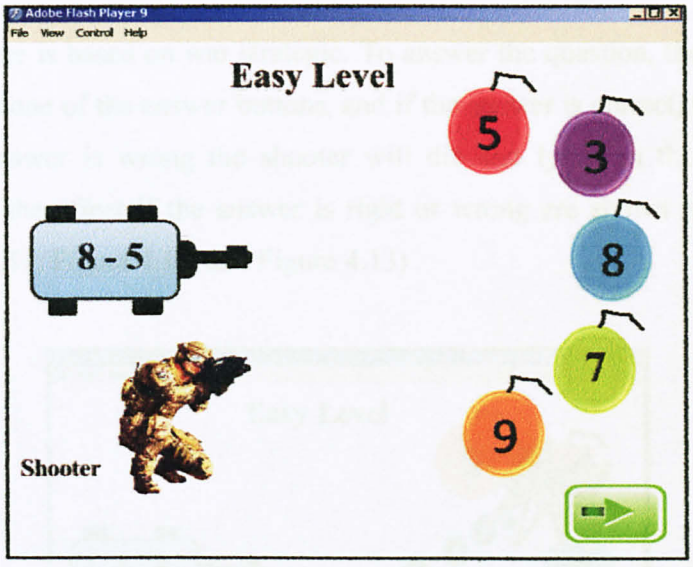

Figure 4.8 Math game space

The Math game space was shown as Figure 4.8 is where the slow learners can interact with the application. The interface was simple and well organized. There are five answer buttons for easy question. The Mathematical question will appear at the

left side with the tank background. The slow learners can select the right answer by clicking any of the number from the answer buttons as shown in Figure 4.9.

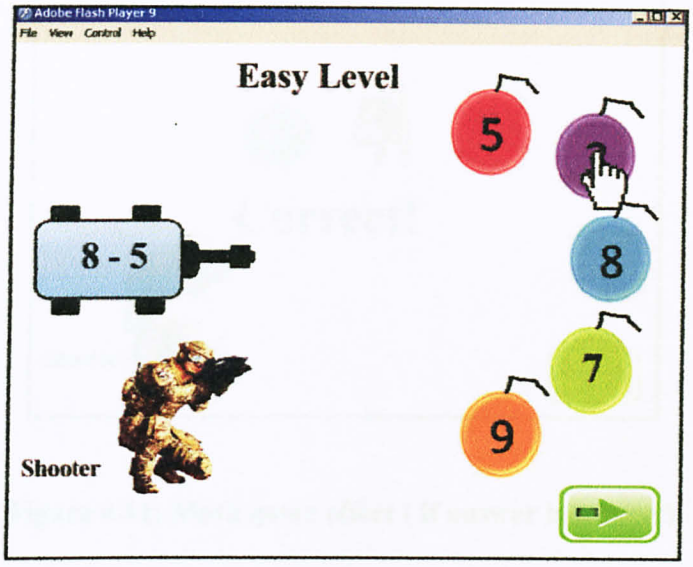

Figure 4.9: Answering the question by clicking the answer button

This math game is based on war strategic. To answer the question, the slow learner needs to press one of the answer buttons, and if the answer is correct, the boom will explode. If answer is wrong the shooter will die and lying on the ground. The screenshot of the effect if the answer is right or wrong are shown below.(Figure 4.10, Figure 4.11, Figure 4.12, and Figure 4.13)

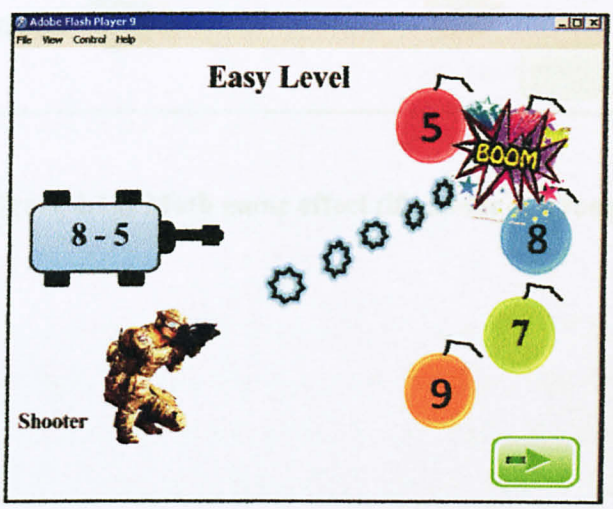

Figure 4.10: Math game effect (if answer is correct)

Figure 4.11: Math game effect (if answer is correct)

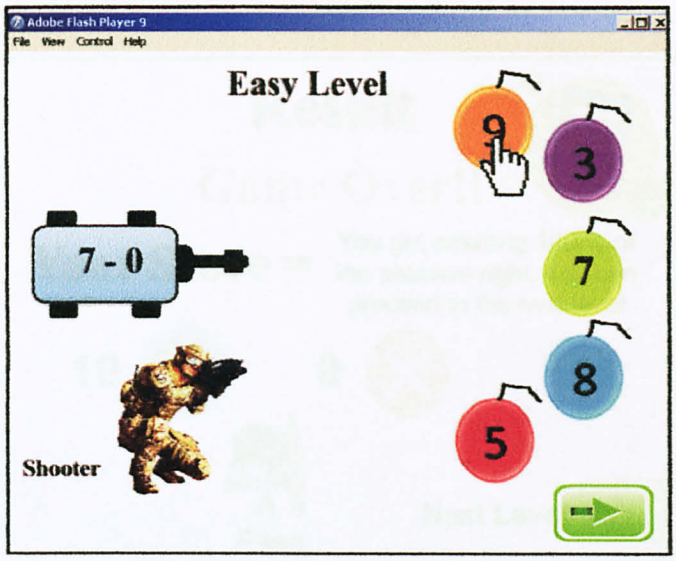

Figure 4.12: Math game effect (if answer is wrong)

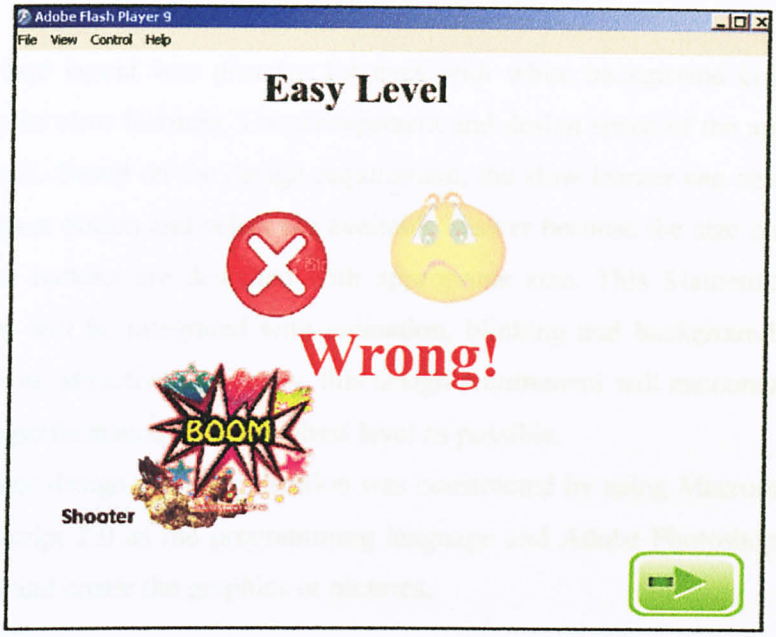

Figure 4.13: Math game effect (if answer is wrong)

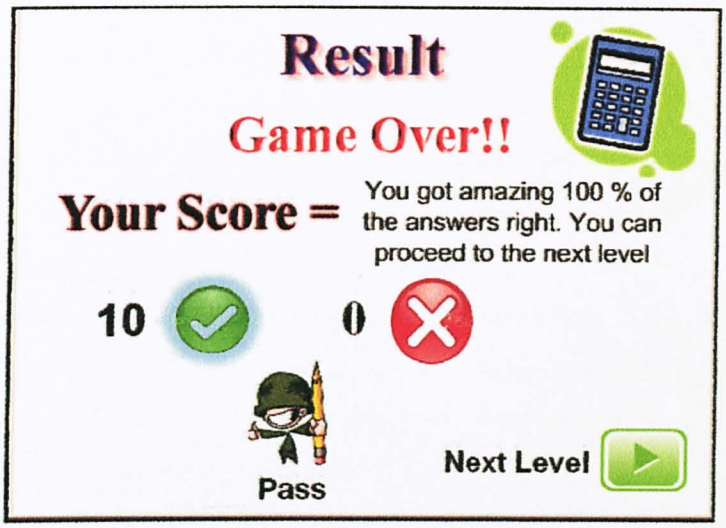

Figure 4.14: Math game result

At the end of every Math game level, the result will be calculated as shown in Figure 4.14. It was to determine whether the slow learners can proceed to the next level or repeat the same level if he or she was failed. To proceed to the next level, the slow learners need to score at least 70%. If the slow learners got less than 70%, he or she needs to repeat or retry the same level until he or she manage to get 70% and above.

The interface layout was pleasant for eyes with white background color and not confusing the slow learners. The arrangement and design space of the application is fully utilized. Based on the design requirement, the slow learner can easily to click on the answer button and select the available answer because the size and shape of the answer buttons are designed with appropriate size. This Mathematical game application will be integrated with animation, blinking and background sound, so that it is more attractive. Indirectly, this design requirement will encourage the slow learners to performance at their highest level as possible.

The interface design of the application was constructed by using Macromedia Flash 8, ActionScript 2.0 as the programming language and Adobe Photoshop CS3 as a tool to edit and create the graphics or pictures.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

Game-based learning has been widely use for children's learning. It is also as an effective medium or good learning strategy for the slow learner. This research project introduced a system application for the courseware which is mathematical game-based learning based on flash application. This section will conclude the study and provide some recommendation.

5.1 Conclusion

The game-based courseware for the slow learners is a good learning strategic which will helps them to gain knowledge in effective and interactive way. This courseware designed with interactive interfaces and easy to use by the slow learners. It is based on educational game and mastery learning theory which is focused on Mathematical operations. It is also beneficial for kindergarten children to learn the fundamental of Mathematic subject. The courseware system was been developed using the Rapid Application Development (RAD) methodology. In this methodology, prototyping is used to help users visualize and request changes to the system as it is being built and allowing applications to evolve iteratively. This courseware makes learning more fun and comfortable for slow learners. It is also benefited them to strengthen their skills in order to master the new concepts.

5.2 Recommendation

The author was successful develop the Mathematics game-based courseware and meet the objectives. Based on the research in this project, there are some criteria still can be improve in order to meet the slow learner needs such as the application design

and using multi touch screen technology rather than mouse click to select the answer on the screen. This future improvement is useful and allows the instructor and slow learner to interact simultaneously with the application. The learning process will become more effective and interactive.

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APPENDIX 1

Final Year Project 2 Gantt Chart

Process
Suggested Milestone

NO	DETAIL	WEEK																	
		1	2	3	4	5	6	7		8	9	10	11	12	13	14	15	16	17	18
1.	Submission of progress report 1																			
2.	Preliminary research work																			
3.	Submission of progress report 2																			
4.	Project work																			
	Research on sample of application (Mylexics)																			
	Research on flash application and ActionScript 2.0																			
5.	Poster presentation																			
6.	Research continue																			
7.	Project work continue																			
	Enhance the Interface Design for Mathematic game application																			
8.	Submission of dissertation (soft bound)																			
9.	Oral Presentation																			
10.	Submission of dissertation (Hard bound)																			

MID-SEM BREAK